March 19, 1963 R. P. P. GUILLOU-KEREDAN 3,081,747

BOILER

Filed Nov. 26, 1957 2 Sheets-Sheet 1

FIG. 1

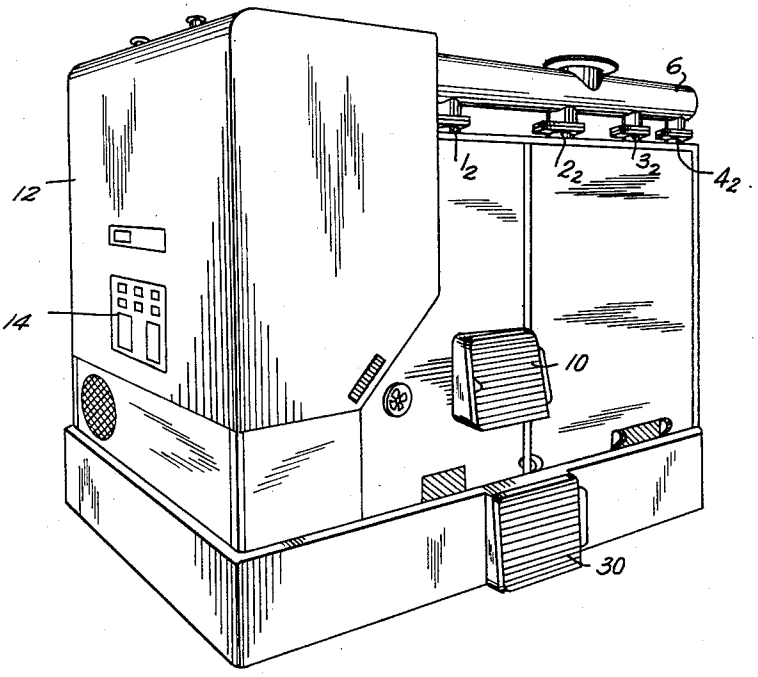
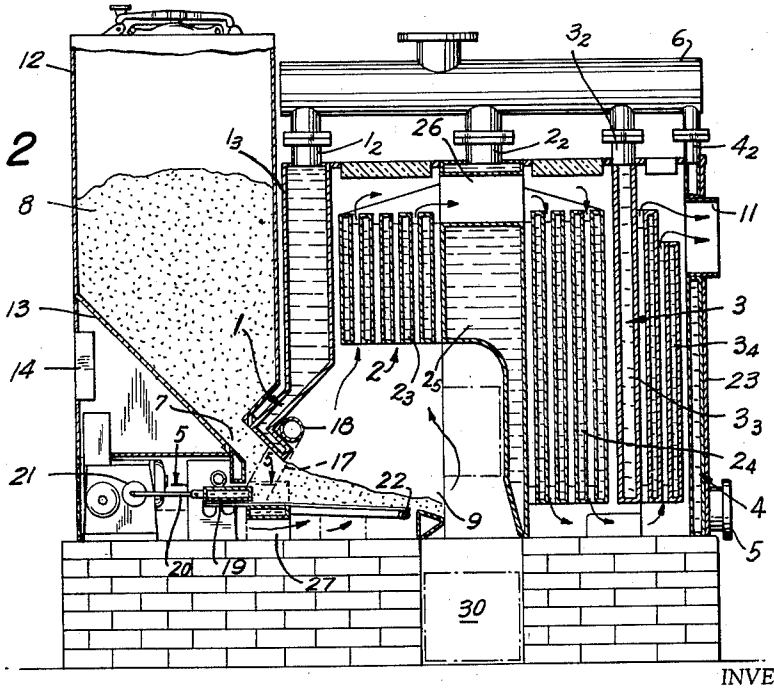


FIG. 2



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FIG. 3

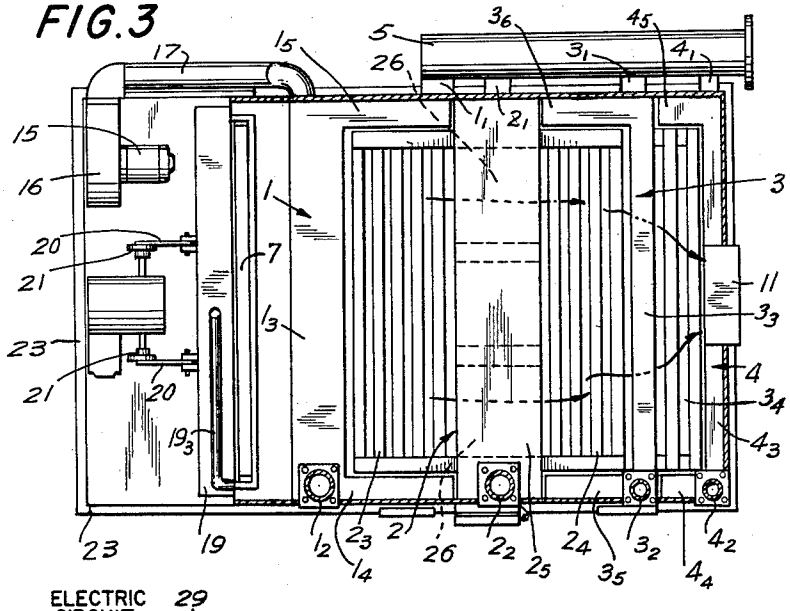


FIG. 4

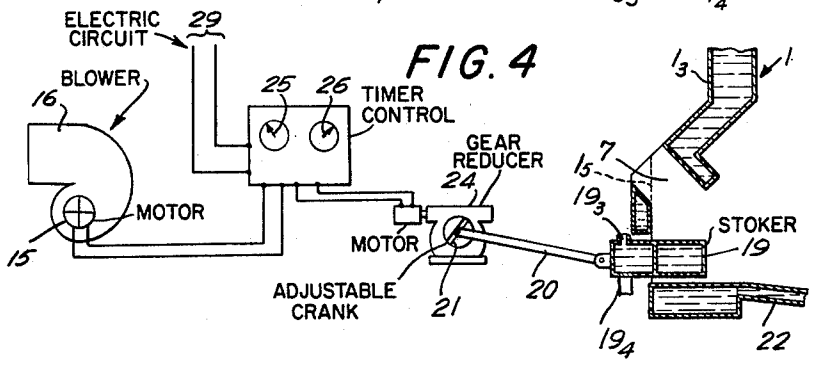
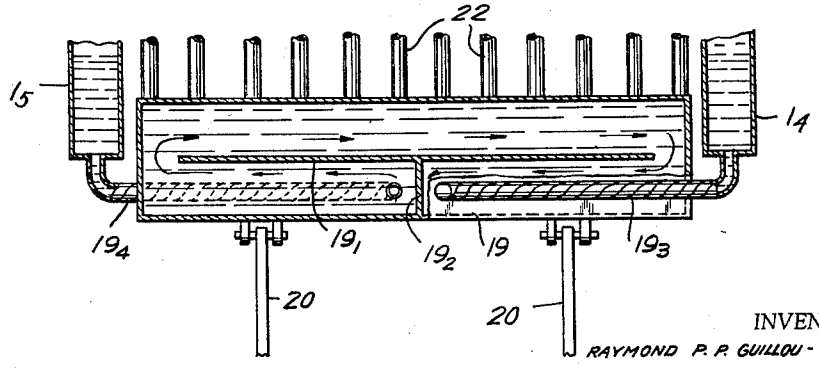


FIG. 5



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BOILER

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9 Claims. (Cl. 122—225)

The present invention relates to a boiler for producing hot water or steam, intended more particularly for heating buildings and premises by means of central heating or similar plants.

Known boilers used for this purpose comprise heat exchanger groups formed either of nests of tubes, or by flat intercommunicating elements defining films of water. In this latter case, the films of water are ordinarily arranged parallel to each other and extending parallel to the longitudinal direction of the circulation of the burnt gases coming from the furnace.

These prior heat exchangers have several disadvantages:

(*a*) Unequal heating of the walls of the exchanger, the wall nearest to the furnace being violently heated, whereas the lateral and rear faces are at distinctly lower temperatures, thus causing an evaporation or heating of localized water. Moreover, this unequal heating subjects the steel plates of the elements to appreciable fatigue owing to expansion differences;

(*b*) The conduits of the gas passage of the exchanger comprise devices, baffle plates or the like, piping the smoke and increasing its circulation speed in various directions; at the spots where the smoke speed is greater there is noticeable wear of the walls of the exchanger.

One of the purposes of the invention is to obviate these disadvantages and hence to produce a boiler in which the heating of all the walls of the exchanger elements is equalized, thus affording a more uniform and reduced wear of the steel plates and a better heat exchange operation.

Another purpose of the invention is to produce a boiler whose exchanger does not include a baffle plate, thus ensuring less wear of the walls by fly ash.

The invention also has the purpose of producing a boiler whose maintenance and supervision can be reduced to a minimum once it has been started up, due to an automatic feed, and more particularly with regard to the fuel feed and stoking of the furnace when operating with small coal.

In certain known boilers with gravity fuel feed, the furnace is equipped with an automatic or hand-operated stoker, but generally working at very long intervals to the extent of several hours. This stoker has the effect of ejecting the residues of the fuel burnt on the grate, into a hole or ash-pit. In withdrawing, the stoker enables the fuel fed by gravity to form a fresh heap on the grate.

The disadvantage with such devices, even when the control is automatic, is that the power of the fire-chamber of the boiler is very substantially diminished when stoking, firstly, owing to the accumulation of ashes and cinders and then by the arrival in bulk of fresh fuel which must first become retorted before active combustion takes place. This discontinuity in running also has the disadvantage of requiring both the regulation of primary and of secondary air, which is detrimental from the standpoint of output and operation. Furthermore, the ejection of the cinders and dross situated on the grate does not occur without taking along a certain quantity of unburnt fuel.

The invention also has the purpose of obviating these disadvantages by producing a boiler in which the fuel is

admitted and the ashes ejected in correspondingly small quantities, which does away with fits and starts in the automatic working of the boiler.

By adapting regulating devices to this boiler that act either on the amplitude of the stroke of the stoker, or on the idle or working periods of the stoker when it is operated intermittently, it is possible accurately to regulate the running of the boiler and keep it running steadily and in an entirely automatic manner.

The aims and advantages of the invention are attained with the means and devices hereinafter described.

A boiler according to the invention is shown, by way of non-restrictive example, in the accompanying drawings, in which:

FIGURE 1 is a perspective view of the boiler;

FIGURE 2 is a cross-sectional view of the boiler;

FIGURE 3 is a top view of the boiler, the cleaning plugs and hopper being removed;

FIGURE 4 is a diagram illustrating the devices for controlling and regulating the stoker; and

FIGURE 5 is a partial plan sectional view showing the stoker, this view being taken along the line 5—5 in FIGURE 2, and illustrating the flexible connecting tubes for the circulation of the cooling water to and from the stoker.

The boiler shown in the attached drawings, is characterized, in the first place, by its heating structure.

This exchanger consists of four exchanger units **1**, **2**, **3** and **4**, arranged one behind the other, along the same longitudinal axis of the boiler, it being understood that the front face of the boiler is that carrying the instrument panel for the electric control which can be seen in FIGURE 1.

All these units are individual, i.e., that they each comprise an inlet for water (please see FIGURE 3) respectively 1_1, 2_1, 3_1, and 4_1 and an outlet respectively 1_2, 2_2, 3_2, and 4_2 for water. Each water inlet is situated at the bottom part of its unit, and connected to an inlet collector or supply manifold **5**, common to all these inlets. Each water outlet is situated at the top part of its unit and connected to a departure collector or return manifold **6**, common to all these outlets.

The inlet collector is situated at the bottom part of one of the lateral sides of the boiler, whereas the departure collector is situated above the boiler, on the side opposite to the preceding collector.

The exchanger is divided transversally in relation to the longitudinal axis of the boiler and in the general direction in which the smoke circulates, i.e., so that in the example under consideration, the elements of the exchanger are placed according to vertical planes parallel to the front face of the boiler. In this manner, the exchange walls are flat and parallel to each other and the water contained in the exchanger is distributed in transversal films; an arrangement of this kind ensures that the whole of the surface of each exchange wall is evenly heated, even those walls in the most direct contact with the furnace, which ensures a homogeneous distribution of the work rates required from each flat wall. Moreover, the vertical arrangement of the elements of the exchanger reduces soot deposits and facilitates sweeping.

The various units comprising the heating structure shown in FIGURES 2 and 3 are:

(*a*) a furnace unit **1**;
(*b*) an exchanger furnace unit **2**;
(*c*) an intermediate exchanger unit **3**;
(*d*) a rear exchanger unit **4**, including a smoke outlet.

The furnace unit **1** has two side planar containers of water 1_4 and 1_5 as shown in FIGURES 3 and 5, and it includes a forward compartment 1_3 for water so shaped

at its lower front part that it surrounds the supply opening 7 for the fuel 8. The furnace unit 1 is integral with the water circulation grate 22 and feeds water to cool the fuel stoker, as will be seen farther on. The furnace unit 1 has a generally U-shape as seen in plan view defined by the forward compartment and the pair of spaced side compartments 1_4 and 1_5.

The exchanger furnace unit 2 is formed of two nests of vertical elements 2_3 and 2_4 situated in cantilever relationship on either side of a caisson 2_5. The forward nest of vertical elements 2_3 placed in front of the caisson 2_5 projects forwardly into the fire box so as to fit between the two side planar containers 1_4 and 1_5, and this forward nest of vertical elements 2_3 is reduced in height so as to provide space for the combustion chamber 9. Moreover, the caisson 2_5 is hollowed out at its lower front part, so as to afford access to the furnace through the inspection port 10 and to provide a sufficient volume for the combustion chamber.

Passages 26 are provided at the top part of the caisson 2_5 at a level higher than the nests of vertical elements 2_3 and 2_4 to enable smoke to be carried off as shown by the flow arrows, and to provide a long flow path for extracting heat from the gases.

The exchanger unit 3 consists of a water-compartment 3_3 with a nest of vertical elements 3_4 at the rear. The vertical elements successively diminish in height towards their top part, so that they afford a better passage for smoke towards the outlet opening 11. The exchanger unit 3 has a generally U-shape as seen in plan view defined by the transverse water compartment 3_3 and a pair of spaced side compartments 3_5 and 3_6 extending forwardly therefrom on opposite sides of the boiler so that the second nest of vertical elements 2_4 fits between them.

The rear unit consists of a water-compartment 4_3 through which the opening 11 for carrying off smoke is made. A pair of spaced side water compartments 4_4 and 4_5 extend forwardly from the rear compartment on opposite sides of the boiler so as to define a generally U-shaped unit as seen in plan view. The third nest of vertical elements 3_4 projects rearwardly and fits between the side compartments of the rear unit as seen in FIGURE 3.

On the entire periphery of the boiler there are heat-insulating jackets 23.

The boiler comprises a hopper 12 for gravity-feeding the furnace, i.e., it is shaped at its lower part so as to have an oblique plane 13 down which the coal flows to the furnace.

At its bottom part, the hopper has a supply opening 7 which emerges in the furnace, and through which the coal 8 flows, this opening being surrounded by the bottom part of the water-compartment 1_3 of the furnace unit 1, as already mentioned.

The hopper 12 is positioned with one of its faces against the water-compartment 1_3 of the furnace unit. Its opposite wall forms the front wall of the boiler, this front wall acting to support on its external face, an electric control panel 14.

In the space provided under the oblique plane 13 of the hopper, there are, on the one hand, a primary and secondary air system, and on the other, an automatic pusher or stoker system for feeding fuel into the furnace.

The ventilating device in question comprises a motor 15 which drives a centrifugal fan 16. Part of the air blown by the fan is conveyed as primary air under the grate 22 through the passage 27, which extends generally horizontally back beneath the grate.

Another part of the air is blown into a pipe 17 (FIGURE 2) and goes to the combustion chamber 9 in which it emerges through a distributor 18 for distributing secondary air situated above the fuel heap.

The pusher 19 as shown in FIGURE 5 is formed by a hollow caisson having a longitudinal partition 19_1 which is open at its two ends, and a transverse half-partition 19_2. The pusher is connected with the water jacket of the fire box in one place on the shell 1_4 by a flexible metal coupling 19_4 and in another place on the shell 1_5 by a similar coupling 19_3, this connection allowing the reciprocating movements of the pusher. Thus, there is provided a circulation of the water within the pusher in the direction of the arrow, resulting from these connections with the water jacket.

In the example shown, the stoker 19 has an alternating movement imparted to it by means of a connecting-rod 20 and crank 21 system. The amplitude of the stroke of this stoker, which is adjustable, for example, by means of an adjustable crank-pin, is short. This stroke is, for example, about 2 to 6 cm. On the other hand, this stoker is activated, if not continuously, at least at relatively short intervals of time, being every few minutes. In this manner, the fuel is admitted into the furnace, and ashes ejected into the ash-bin 30 in small and corresponding quantities. Consequently, there are always, on the grate of the furnace, quantities of coal retorting, in active combustion and burnt, which are regular, so that there are no fits and starts in the way in which the boiler is stoked.

By regulating the stroke, idle and working times of the stoker, which can be selected in relation to the quality and size composition of the fuel, the boiler can be run in a very flexible manner, while having a fuel feed and stoking that are entirely automatic, and resulting in an extremely reduced quantity of unburnt fuel.

It therefore ensues that as there is a mass of fuel in the furnace in a steady state of combustion, the regulating of the boiler is thus effected under the best running and output conditions, this being done once and for all with a given fuel.

Lastly, in the case of the example shown, where the boiler comprises a forced draught by fan 16 blowing air, the working of the stoker is subjected to that of the fan so as automatically to regulate the fuel intake and stoking in relation to the power required from the boiler. Instead of a blowing fan, a fan can be used that sets up a pressure decrease in the smoke-stack.

FIGURE 4 shows diagrammatically the devices for operating and regulating the stoker. The reducing-gear-motor unit 24 driving the stoker is included in a circuit 29 connected up to the motor 15 of the fan 16 and there is a dual clockwork device included in this circuit, the timer 25 enables the frequency of the stoking to be regulated, and the timer 26 enables the duration of each stoking to be regulated.

The feed of this boiler can thus be regulated according to the quality of the fuel and the frequency and amplitude of stoking.

It goes without saying that the invention is not restricted to the examples of embodiment precisely described and shown, from which other alternatives could be obtained, without going outside the scope of the invention for that purpose.

What we claim is:

1. In a boiler for water having a fire box therein, a water heating structure for water comprising a supply manifold, a return manifold, a plurality of independent heat exchange units interfitting one with another, each of said independent units being connected to each of said manifolds, a first of said heat exchange units having a generally U-shape as seen in plan view defined by a front upright water compartment and a pair of laterally spaced upright side water compartments extending rearwardly from opposite sides of the front compartment and communicating therewith, said front compartment defining a front surface of the fire box and said spaced side compartments defining opposite sides of the fire box, a second of said heat exchange units having a main water compartment defining the rear surface of the fire box, said second unit including a first nest of hollow upright

layer elements, said nest projecting forwardly from the upper part of said main compartment and fitting into said U-shaped first unit between said side compartments of the first unit and above said fire box, said layer elements of the first nest extending transversely of the structure and defining a plurality of upright passages for hot gases rising from the fire box, said second unit having a second nest of hollow upright layer elements, said second nest projecting rearwardly from said main compartment, said layer elements of the second nest defining a plurality of upright passages for hot gases passing downwardly therethrough, means conveying the hot gases from the top of said first nest to the top of said second nest, and a third of said heat exchange units having a generally U-shape as seen in plan view defined by a second pair of laterally spaced upright side water compartments extending forwardly from opposite sides of a transverse intermediate compartment, said second nest projecting rearwardly and fitting into said U-shaped third unit between said second pair of side compartments.

2. In a boiler as claimed in claim 1, a heating structure for water wherein said third heat exchange unit has a third nest of hollow upright layer elements projecting rearwardly from said transverse intermediate compartment and defining a plurality of upright passages for hot gases passing upwardly therethrough, and means conveying the hot gases from the bottom of said second nest to the bottom of said third nest.

3. In a boiler as claimed in claim 2, a heating structure including a fourth heat exchange unit having a U-shape as seen in plan view defined by a rear compartment and a third pair of spaced side compartments, said third nest projecting rearwardly and fitting into said U-shaped fourth unit.

4. In a boiler for producing hot water or steam, a heating structure comprising a combustion chamber and a heat exchanger formed by a plurality of independent integral heat exchange units each adapted to be connected at their lower portions to a common supply manifold and adapted to be connected at their upper portions to a common return manifold, a first of said units including a front upright water compartment with a pair of spaced upright side water compartments extending rearwardly therefrom along opposite sides of the boiler, said front compartment and said pair of side compartments defining a generally U-shaped unit as seen in plan view and forming the front and side walls of the combustion chamber, a second of said units including a main upright water compartment extending transversely of the boiler and forming the rear surface of the combustion chamber, said second unit including a first nest of upright planar water container elements projecting forwardly from the upper part of said main compartment above the combustion chamber, said first nest fitting into said first U-shaped unit between the side compartments and providing upwardly extending passages for the hot gases between said elements, said second unit also including a second nest of upright planar water container elements projecting rearwardly from said main compartment and providing downwardly extending passages for the hot gases between said latter elements, means conveying hot gases from the top of said first nest to the top of said second nest, and a third of said units including an upright water compartment extending transversely of the boiler with a second pair of spaced upright side water compartments extending forwardly therefrom along opposite sides of the boiler and defining a generally U-shaped unit as seen in plan view, said second nest fitting into said third U-shaped unit between said second pair of side compartments.

5. In a boiler for producing hot water or steam, a heating structure providing a fire box for burning pieces of solid fuel and comprising a plurality of independent integral heat exchange units each adapted to be connected at their lower portions to a common supply manifold and adapted to be connected at their upper portions to a common return manifold, a first of said units including a front upright water compartment with a pair of spaced upright side water compartments extending rearwardly therefrom along opposite sides of the boiler, said front compartment and side compartments defining a generally U-shaped unit as seen in plan view and forming the front and side walls of the fire box, said first unit including a water circulation grate extending across the lower portion of the fire box and integral with said first unit, said front compartment having a fuel supply opening passing therethrough at an elevation above said grate for supplying pieces of solid fuel by gravity feed down onto the grate, a second of said units including a main upright water compartment extending transversely of the boiler and forming the rear surface of the fire box, said second unit including a first nest of upright transverse planar water container elements, said first nest projecting forwardly in cantilever relationship from the upper part of said main compartment above the fire box, said first nest fitting into said first U-shaped unit between the side compartments and providing upwardly extending passages for the hot gases between said elements, said second unit including a second nest of upright transverse planar water container elements, said second nest projecting rearwardly in cantilever relationship from said main compartment and providing downwardly extending passages for the hot gases between said latter elements, and means conveying hot gases from the top of said first nest to the top of said second nest.

6. In a boiler for producing hot water or steam, a heating structure providing a fire box and defining a pathway of flow for the gases in passing out of the boiler, a common supply manifold and a common return manifold, said heating structure comprising a plurality of integral heat exchange units each connected at their lower portions to the common supply manifold and at their upper portions to the common return manifold, a first of said units including a front upright water compartment with a pair of spaced upright side water compartments extending rearwardly therefrom along opposite sides of the boiler, said front compartment and side compartments defining a generally U-shaped unit as seen in plan view and forming the front and side surfaces of the fire box, and a second of said units including a main upright water compartment extending transversely of the boiler and forming the rear surface of the fire box, said second unit including a first nest of upright transverse planar water container elements, said first nest projecting forwardly in cantilever relationship from the upper part of said main compartment above the fire box, said first nest fitting into said first U-shaped unit between the side compartments and providing upwardly extending passages for the hot gases between said elements, said second unit including a second nest of upright transverse planar water container elements, said second nest projecting rearwardly in cantilever relationship from said main compartment and providing downwardly extending passages for the hot gases between said latter elements, said main compartment having an upper portion rising to a level above said nests and having a passage through said upper portion for conducting the hot gases therethrough from the top of said first nest to the top of said second nest.

7. In a boiler for producing hot water or steam, a heating structure providing a fire box and defining a pathway of flow for the gases in passing out of the boiler, a common supply manifold and a common return manifold, said heating structure comprising a plurality of independent integral heat exchange units each removably connected at their lower portions to the common supply manifold and at their upper portions to the common return manifold, a first of said units including a front upright water compartment with a pair of spaced upright side water compartments extending rearwardly therefrom

along opposite sides of the boiler, said front compartment and said pair of side compartments defining a generally U-shaped unit as seen in plan view and forming the front and side surfaces of the fire box, a second of said units including a main upright water compartment extending transversely of the boiler, the front surface of said main compartment forming the rear surface of the fire box, said second unit including a first nest of hollow upright transverse layer elements, said first nest fitting into said first U-shaped unit between the side compartments and providing upwardly extending passages for the hot gases rising from the fire box and passing between said elements, the front surface of said main compartment being cut away beneath said first nest for providing an enlarged space at the rear of the fire box, said second unit also including a second nest of hollow upright transverse layer elements, said second nest being positioned rearwardly from said main compartment and providing downwardly extending passages for the hot gases between said latter elements, said main compartment having a passage therethrough for conveying hot gases from the top of said first nest to the top of said second nest, a third of said units including an upright water compartment extending transversely of the boiler with a second pair of spaced upright side water compartments extending forwardly therefrom along opposite sides of the boiler and defining a generally U-shaped unit as seen in plan view, said second nest fitting into said third U-shaped unit between said second pair of side compartments, and an access door in the side of said boiler aligned with the cut away front surface of said main compartment at the rear of the fire box.

8. In a boiler for producing hot water or steam, a heating structure having a combustion chamber and comprising a heat exchanger formed by a plurality of heat exchange units joined together, said heat exchanger units being adapted to be connected at their lower portions to a common supply manifold and being adapted to be connected at their upper portions to a common collector manifold, the first of said units including a front double wall and a pair of side double walls at opposite sides of the boiler forming a unit having a U-shape as seen in plan view and defining the front and sides of the combustion chamber, the second of said units including a double wall transverse of the boiler and defining the rear of the combustion chamber, said second unit including a first group of hollow layers for holding water positioned at the top of the combustion chamber and between the side double walls of the first unit, said group providing passages for the hot gases, said second unit also including a second group of hollow layers for holding water positioned behind said double transverse wall and extending toward the bottom of the boiler and providing passages for the hot gases, means for conveying the hot gases from said first group to said second group, and a third of said units including a second double wall transverse of the boiler and a second pair of side double walls extending toward the front of the boiler along opposite sides of said second group having a U-shape as seen in plan view.

9. In a boiler for the production of hot water or steam, a heating structure having a combustion chamber and comprising a heat exchanger formed by a plurality of heat exchange units joined together, a cold water supply manifold connected to the lower parts of said units and a collector manifold connected to the upper parts of said units, the first of said units including a double-walled front and a pair of double-walled sides at opposite sides of the boiler, defining a unit in the shape of a U in top view and forming the front and sides of the combustion chamber, and a second of said units including a double-walled partition transverse of the boiler and defining the rear of the combustion chamber, said first unit including a fire grate in the lower part of the combustion chamber, said grate having water circulation therethrough and being integral with the first heat exchange unit, said double-walled front of said first heat exchanger unit having a fuel supply opening therethrough for the passage of pieces of solid fuel fed by gravity, an automatic fuel pusher positioned below said fuel supply opening, said pusher being hollow and being connected to said first heat exchange unit by flexible connections for ensuring the circulation of water therethrough, an adjustable reciprocating drive mechanism for said pusher providing an adjustable stroke of low amplitude, said drive mechanism being adjustable in frequency of operation and duration of operation, a forced draft blower for the boiler, and a control mechanism for said blower, said drive mechanism being under the control of said blower control mechanism for automatically controlling the feeding of fuel in accordance with the boiler output required.

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